Institutt for fysikk, NTNU
TFY4155/FY1303: Elektrisitet og magnetisme
Vår 2004

Øving 7

Guidance: 23.02, (24.02), 25.02, 26.02, 27.02, 01.03, 03.03, 04.03
To be delivered by: Thursday March 4 kl. 1200 (Table for your answers on the last page.)

Information:

- Unless otherwise stated, it is assumed that the system is in electrostatic equilibrium.
- Unless otherwise stated, "potential" means "electrostatic potential", and correspondingly for "potential energy".
- Unless otherwise stated, zero (electrostatic) potential and potential energy is chosen infinitely far away.
- You may need some of these: $1/4\pi\varepsilon_0 = 9 \cdot 10^9$ Nm^2/C^2, $e = 1.6 \cdot 10^{-19}$ C, $m_e = 9.11 \cdot 10^{-31}$ kg, $m_p = 1.67 \cdot 10^{-27}$ kg, $g = 9.8$ m/s^2
- Symbols are given in italics (e.g. V for potential) while units are given without italics (e.g. V for volt).

1) An electron
A may have any charge.
B has a charge 1/2000 of the proton charge.
C has a charge 2000 times that of the proton.
D has about 2000 times larger mass than the proton.
E has a mass about 1/2000 of the proton mass.

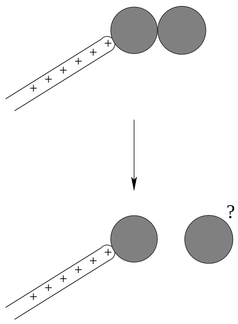
2) A proton
A may have any charge.
B has a charge 1/2000 of the electron charge.
C has a charge 2000 times that of the electron.
D has about 2000 times larger mass than the electron.
E has a mass about 1/2000 of the electron mass.

3) If a body has net charge -160 pC, you may conclude that the body has an excess of
A 10^3 electrons.
B 10^5 electrons.
C 10^7 electrons.
D 10^9 electrons.
E 10^{11} electrons.

4) Two metal spheres attract each other electrostatically. Which statement is then always true?

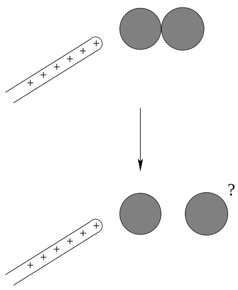
A Both spheres have a net charge.
B At least one of the spheres has a net charge.
C None of the spheres are charged.
D The spheres have the same charge.
E None of the statements above are necessarily true.

5) You touch one (the one to the left) of two neutral metal spheres that are initially in contact with each other, with a positively charged glass rod. Then you take the two metal spheres away from each other. Now, the sphere to the right has



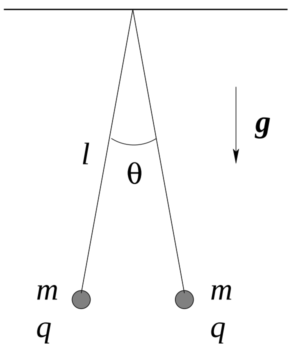
A positive charge.
B negative charge.
C zero net charge.
D a charge opposite to the charge on the left sphere.
E nonzero net charge, but the sign cannot be determined.

6) You bring a positively charged glass rod almost in touch with one (the one to the left) of two neutral metal spheres that are initially in contact with each other. Then you separate the two metal spheres from each other. Now, the sphere to the right has



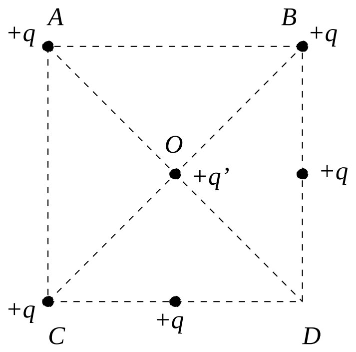
A positive charge.
B negative charge.
C zero net charge.
D the same charge as the sphere to the left.
E nonzero net charge, but the sign cannot be determined.

7) Two small spheres, each with a mass $m = 10$ g and charge q, are hanging in electrically insulating wires with length $l = 10$ cm. The wires are attached to a common point. How big is the charge q if the angle between the wires is $\theta = 30°$?



A $1.6 \cdot 10^{-19}$ C
B $7.8 \cdot 10^{-15}$ C
C $8.8 \cdot 10^{-8}$ C
D $3.0 \cdot 10^{-4}$ C
E 0.017 C

8) Five equal point charges $+q$ are placed on a square as shown in the figure. A sixth charge $+q'$ is placed in the center of the square, in position O. In which direction is the net force on the charge q'?

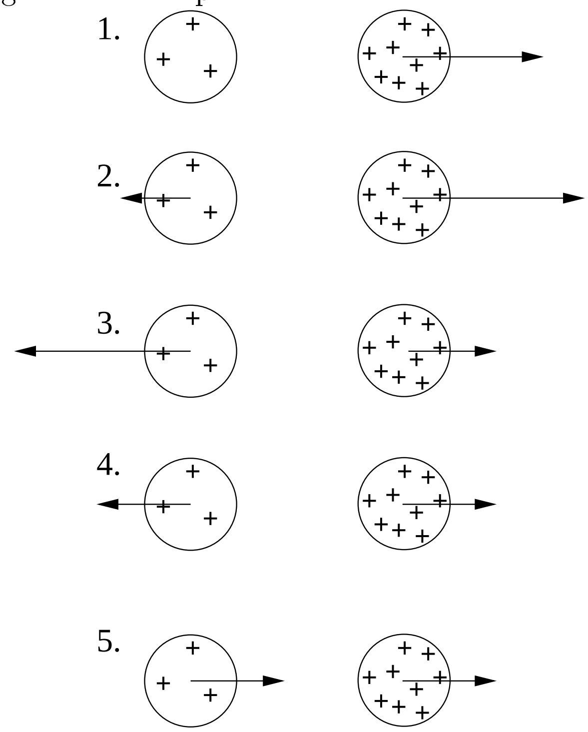


A Along OA.
B Along OB.
C Along OC.
D Along OD.
E It is zero.

9) Three metal spheres are hanging in thin, electrically insulating wires. When you hold spheres 1 and 2 near each other, you observe that they attract each other. When you do the same with spheres 2 and 3, you notice that they repel each other. Then you can conclude that

A spheres 1 and 3 have charge with opposite sign.
B spheres 1 and 3 have charge with the same sign.
C all three spheres have charge with the same sign.
D one of the spheres is electrically neutral.
E we do not have enough information to decide the sign of the charge on all three spheres.

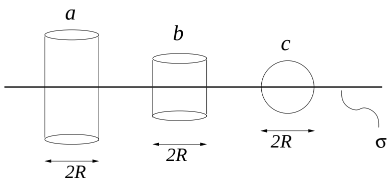
10) Two uniformly charged spheres have charges Q and $3Q$, respectively. Which figure describes correctly the electrostatic forces acting on the two spheres?



A 1.
B 2.
C 3.
D 4.
E 5.

11) A uniformly charged, infinitely large plane surface has a charge σ pr unit area. Three gaussian surfaces (closed surfaces) a, b and c are shown in the figure. The two cylindrical surfaces a and b both have radius R, heights $4R$ and $2R$, respectively, and lie symmetrically around the charged surface with the symmetry axis parallel to the surface normal. The spherical surface c also has radius R and has its center on the charged plane. Through which of the following surface(s) is the electric flux biggest: 1. the top surface (the "lid") of a; 2. the top surface of b; 3. the upper hemisphere of c?

A 1.
B 2.
C 3.
D 2. and 3.
E Equally large flux through all the three surfaces 1., 2., and 3.

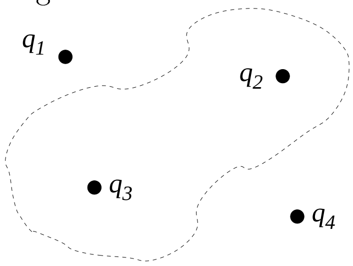


12) Rank the three closed surfaces a, b and c in the figure above, according to increasing electric flux through them.

A $a > b > c$.
B $a = b > c$.
C $a = b = c$.
D $a > b = c$.
E $c > b > a$.

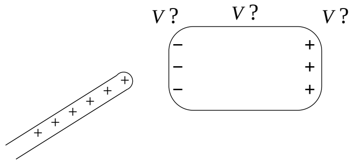
13) The figure to the right shows 4 point charges and a gaussian surface (dashed). Which charges contribute to the net electric flux through the gaussian surface?

A None of them.
B Only q_1 and q_2.
C Only q_2 and q_3.
D All four of them.
E The answer depends on the shape of the gaussian surface.



14) A charged glass rod is brought in the vicinity of an electrically neutral piece of metal, so that the metal obtains an excess negative and positive charge on the left and the right side, respectively, as shown in the figure. On the piece of metal, the electric potential is

A constant everywhere.
B biggest on the positively charged side.
C biggest on the negatively charged side.
D biggest in the middle.
E smallest in the middle.



15) A piece of metal is given a net charge $-Q$. Then the electric potential on the metal piece is

- A constant everywhere.
- B biggest in the middle.
- C biggest on the surface.
- D biggest somewhere between the center and the surface.
- E smallest at the center.

16) Find the wrong statement: Gauss' law for the electrostatic field E

- A is a consequence of Coulomb's law.
- B follows from the fact that E for a point charge decays as $1/r^2$.
- C results in $E = 0$ inside an electric conductor.
- D expresses that the net electric flux through a closed surface is larger, the larger the net charge enclosed by the surface.

17) Find the wrong statement:

- A The surface of a piece of metal is an equipotential.
- B Any closed surface lying entirely inside a piece of metal is an equipotential.
- C Any open (i.e.: not closed) surface lying entirely inside a piece of metal is an equipotential.
- D Any closed surface lying entirely inside a piece of metal always has electric potential $V = 0$.

18) What is not a unit for electric flux ϕ_E?

- A Vm
- B Cm/F
- C Jm/C
- D NV/J

19) If the potential difference between the two metal plates of a parallel plate capacitor is reduced to half its original value, the energy stored in the capacitor is

- A quadrupled.
- B doubled.
- C reduced to half its original value.
- D reduced to one fourth of its original value.

(The distance between the two plates is kept fixed.)

20) Find the correct statement:

A A charged metal sphere has a positive electric potential, regardless of the sign of its net charge.
B A charged metal sphere has a negative electric potential, regardless of the sign of its net charge.
C A charged metal sphere has a positive potential energy, regardless of the sign of its net charge.
D Statements A, B and C are all wrong.

Øving 7 i Elektromagnetisme / Elektrisitet og magnetisme våren 2004

Innleveringsfrist: Torsdag 4. mars kl. 1200.

Navn:

Øvingsgruppe:

Oppgave	A	B	C	D	E
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